Perhaps the most interesting questions raised by the discussion are those concerning the relations between the different schemes, and the extent to which these overlap or supplement one another. In particular, are all cumulative operations obtained under the second plan also obtainable under the first?

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## RECENT PUBLICATIONS.

### REVIEWS.

*Plane Trigonometry with Practical Applications.* By L. E. DICKSON. Chicago, Benj. H. Sanborn and Co., 1922. 4to. 11 + 176 + 35 pages. Price $1.52.

Extracts from the Preface: "This book introduces at an early stage concrete applications of trigonometry to the elementary parts of navigation and surveying, which are the two simplest exact sciences, as well as to the two elementary topics of physics which are known as composition of forces and refraction of light. There is, too, a full explanation of the theory and construction of a Mercator map, a subject of great importance also in geography. Three separate chapters are devoted to these subjects. The necessary terms and ideas are explained at length and illustrated concretely. We thereby obtain an abundance of simple problems whose importance is so convincing that they cannot fail to arouse real interest. Actual experience with classes has firmly convinced the author that these practical applications offer the best means to drive home the principles of trigonometry and to make the subject truly vital. . . .

"The development of the subject is leisurely and the student is given ample time in which to digest each idea. There are given full and lucid explanations of all new terms and ideas. Lack of the precise knowledge of the mathematical meaning of terms is one of the chief sources of difficulty in the study of mathematics. Various terms which should be already familiar to students are re-defined. On the basis of careful readings both of the manuscript and proof sheets by various experienced teachers in high schools and colleges, it is believed that the presentation is throughout both simple and clear.

"The tables are as simple as possible, and accurate for computation to four significant figures, which are ample for all ordinary practical purposes. It is true that some delicate astronomical measurements justify computations with 5, 6, or 7 place tables; but no new theory is involved. The traverse table, which is necessary for navigation and surveying, is really a systematic list of the sides and angles of all right triangles of moderate size. Its additional headings aid in making the present exposition of navigation much simpler than was possible heretofore. The traverse table is extremely useful in all parts of trigonometry and its applications, partly by relieving the monotony of logarithmic computation, but chiefly for the instantaneous checking of computations.

"The chapters on navigation and surveying are each divided into two parts, this making possible either a brief, wholly untechnical, introduction to those applications, or a fuller treatment."

Contents—Chapter I: Trigonometric functions of acute angles, 1–18; Chapter II: Solution of right triangles by means of tables of the natural functions, 19–25; Chapter III: Traverse table; solution of right triangles by inspection; problems on forces and refraction of light, 26–33; Chapter IV: Logarithms, slide rules, 34–47; Chapter V: Solution of right triangles by logarithms, 48–58; Chapter VI: Navigation: dead reckoning. Part I, the sailings (true course assumed). Part II, finding the true course; compass corrections, 59–81; Chapter VII: Land surveying. Part I, balancing a survey, area (true bearings assumed). Part II, surveying instruments; finding true bearings, 82–102; Chapter VIII: Trigonometric functions of any angle, 103–114; Chapter IX: Solution of oblique triangles, 115–132; Chapter X: Relations between functions of several angles, 133–149; Chapter XI: Graphs of the trigonometric functions and their inverses, radians, 150–167; List and index of formulas, 169–170; Index, including index to definitions, 171–172; Answers to certain of the first five exercises of each set, 173–176; Tables, 1–35.

The numerous textbooks that have been prepared by Professor Dickson, to say nothing of his more technical work, have throughout been characterized by a

logical directness and independence of treatment that are as refreshing as they are rare. First year college students, while seldom consciously critical, reflect by their loss of interest and decreased comprehension every carelessness on the part of the textbook writer and of the teacher. The merits of such a treatment as that here given are so obvious that any remark that might seem to convey a reflection upon the minor details of style may be out of place. For the prospective user of this text the following points may be mentioned. The treatment differs markedly from that customary for engineering texts. Perhaps the difference may be balanced by the method of presentation, but as a text, two features are fairly obvious. Most of the numerous relations that the good student prefers to work out as occasion may demand, but which the poor student, unfortunately, prefers to memorize, are not tabulated conspicuously in this text. This has the disadvantages of failing to impress the important features at a casual glance despite the warnings in the text, and also of making future reference inconvenient. That this remark is not an unfair one will doubtless be granted by any one who glances at the text. For example, the definitions of the cotangent, secant and cosecant are not given directly in terms of the adjacent side, opposite side and hypotenuse, but these functions are defined as the reciprocals of the tangent, cosine, and sine respectively. The values of the functions of 30°, 45°, and 60° are left to exercises as are also the signs of the functions in the several quadrants. Even the formulas which are labeled are not displayed in heavier type to catch the eye. The second conspicuous feature of this text is the number of technical suggestions made but left undeveloped. These undoubtedly add interest but lengthen the amount of time spent. For example, there is a description of the slide rule but no exercises in its use. It is to be presumed that the author does not expect the class to make actual use of this most convenient instrument. From the description given, it is at least dubious if a student could pick up a facility in the handling of a slide rule, and in fact it is hinted that the booklet which usually accompanies the sale of the instrument is to be relied upon. One may question the real utility of descriptions of instruments which the student does not see and handle, while if the instruments are at hand for examination the brief description in the text is superfluous. Similar remarks apply to the surveying instruments. It would have been of interest to have included also the sextant on account of its interesting geometrical theory, if so much less interesting an instrument as the surveyor's transit is regarded as deserving three pages of discussion and a full page cut.

The author says in his preface, "The great majority of students of trigonometry, whether in the high school or the college, take it as their final course in mathematics. Hence the course should justify itself at the time and not be merely a stepping stone to further mathematical subjects. Without overlooking the needs of the few who will go further in mathematics, we may justify trigonometry to the others by demonstrating its great utility by means of simple applications to various subjects that are vital in the world today." For the student of considerable imagination if not for all students this purpose has been well achieved

here. One might be inclined to question the value of this point of view for certain classes of students. Might not one regard the few "practical" problems always found in current texts as a sufficient hint of the practical side of the subject? Might not a good student obtain an even clearer insight into the utility of the subject, granted the time to cover such a book as this, if spherical trigonometry and its applications were included at the expense of problems in plane navigation and the refraction of light? Such queries must be answered by the individual teacher, as well as the more fundamental question as to whether the subject of trigonometry merits the time that a book of this sort will require to cover satisfactorily. In any case this text is urged upon the consideration of prospective teachers of the subject for its original and beautifully logical treatment in simple, clear style of a hackneyed but important course in elementary mathematics.

ALBERT A. BENNETT.

*Loose-Leaf Outlines in Mathematics.* By ROBERT R. GOFF. Boston, The Palmer Company. *Algebra,* 1920, 31 pages. Price $ .50. *Observational Geometry and Numerical Trigonometry,* 1922, 35 pages. Price $ .50.

The ideal method of conducting a mathematical class may depend upon the personality of the teacher even more than upon the content of the course or the preparation of the pupil. While lecture courses in which the students take notes as a basis for subsequent private study may prove entirely satisfactory for graduate courses in a university, there may be a question as to whether this is usually an ideal procedure in a subject like mathematics. Lectures are well adapted to advanced students if the subject matter is readily absorbed and merely an intelligent memory is required. The standard technique in undergraduate instruction in mathematics is undoubtedly to assign portions of a text for home study, designate certain problems to be completed outside of class, discuss and explain difficult points, and spend the remainder of the class period in testing the mastery that the students may have acquired of topics already assigned.

Other modes of attack are possible. In some places home work is reduced to a minimum. Laboratory methods are occasionally very successful in the hands of an enthusiastic teacher. A feature may be made of open discussion, or the subject may be taken up in a "reading course." The work may be handled in the character of a puzzle. A significant question to be asked is, how far does the student in fact utilize the explanations in the text. It is the reviewer's experience that the mind of the college freshman, at least, reacts far more vividly to a single illustrative example than to any discussion, long or short, of the principles involved. The college student is at first, if not eventually, inductive and general statements while readily memorized are applied only with difficulty until numerous examples have emphasized their significance. A question which the teacher must keep constantly in mind is as to just how far the student should be allowed to acquire mere dexterity accompanied by memorized rules (something that the otherwise poor student enjoys), and how far the